

The Move Toward Analysis Ready Data and the Opportunities / Challenges Ahead

April 14, 2016

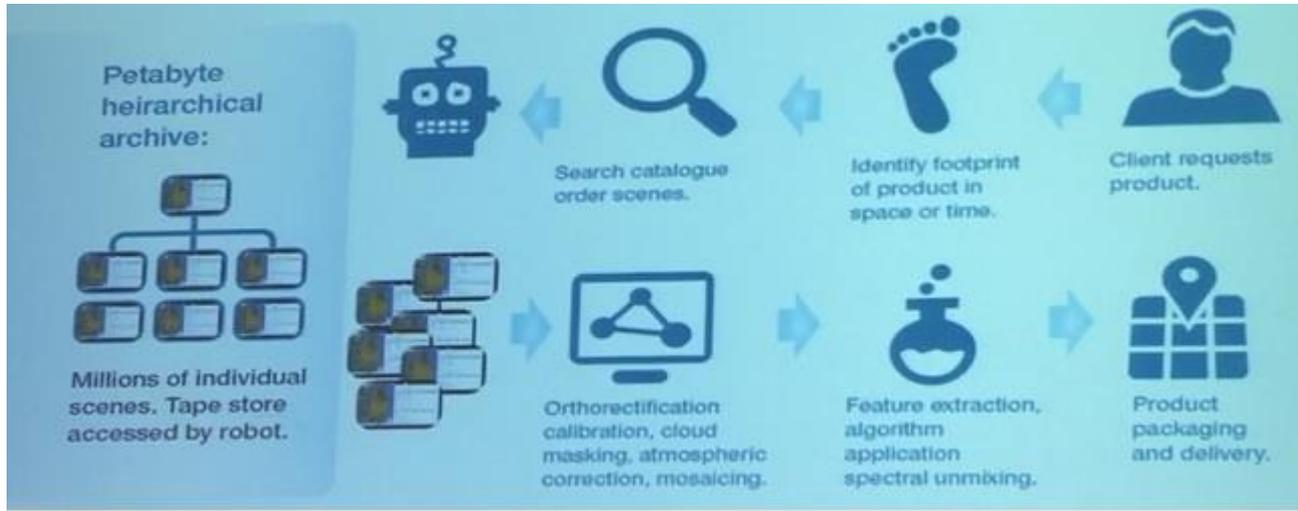
Presented By:

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Traditional Product Cycle

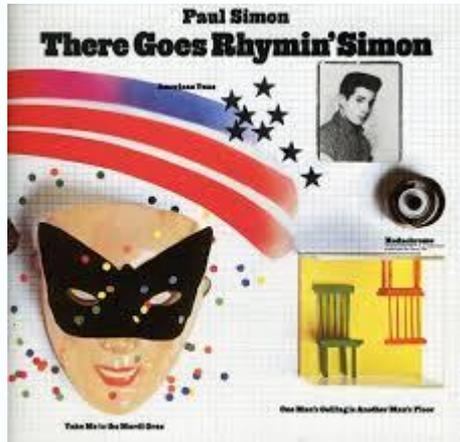


Courtesy of Geoscience Australia

Complexities / Challenges

- RELATIVE and ABSOLUTE ACCURACY, Spatial, Spectral
 - Single sensor
 - Single Mission – multi-sensor simultaneous acquisitions
 - Single series
 - Two Missions (e.g. CBERS 4-Landsat-8, Sentinel-2A – Landsat 8)
 - HLS = Harmonized Landsat Sentinel products
 - **“Make look like SLI vice Landsat or Sentinel” (Kurt Thome - Apr 12)**
 - Similar spectrum
 - Diverse Spectrum
 - Multiple View Angles
 - Etc.
- Standards, Methodologies and Best Practices
 - Cube Implementation Choice - Use of Cloud Service?
 - Gridding
 - Projection interoperability
 - Timeliness

“One Man’s Ceiling is Another Man’s Floor”





Analysis Ready Data?





Themeda Triandra



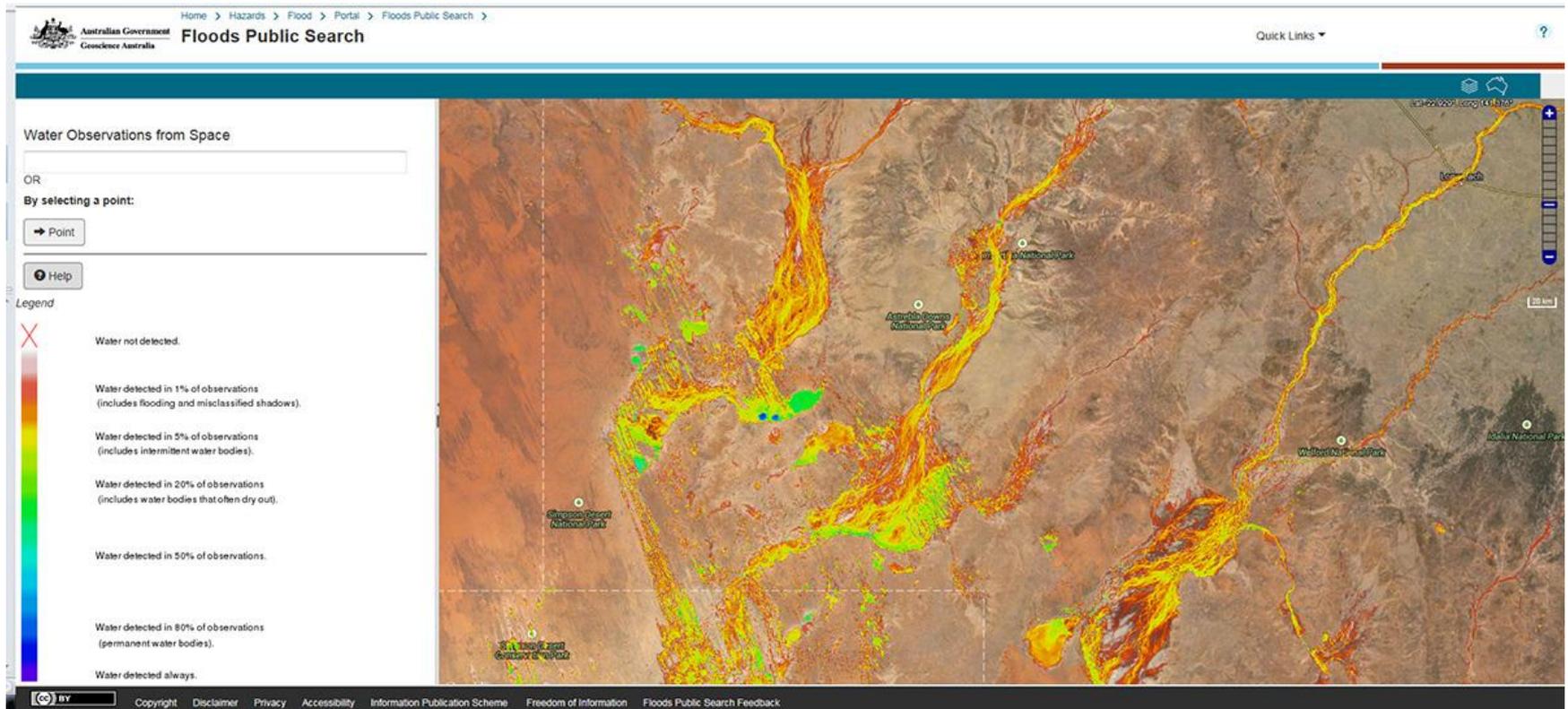
Analysis Ready Data (ARD) Concepts

Geoscience Australia ARD for GA Data Cube

USGS ARD for LCMAP

CEOS ARD for Data Cubes

Geoscience Australia Water Observations from Space



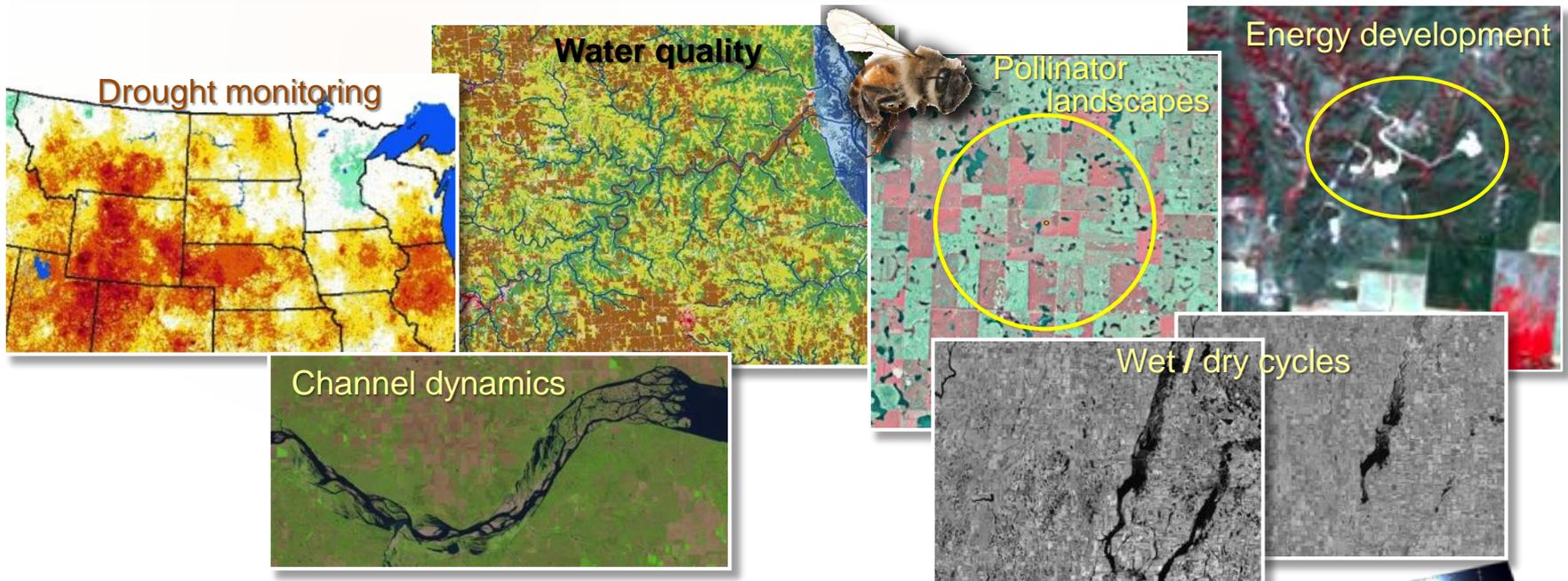
Recall April 12 – USGS Presentation

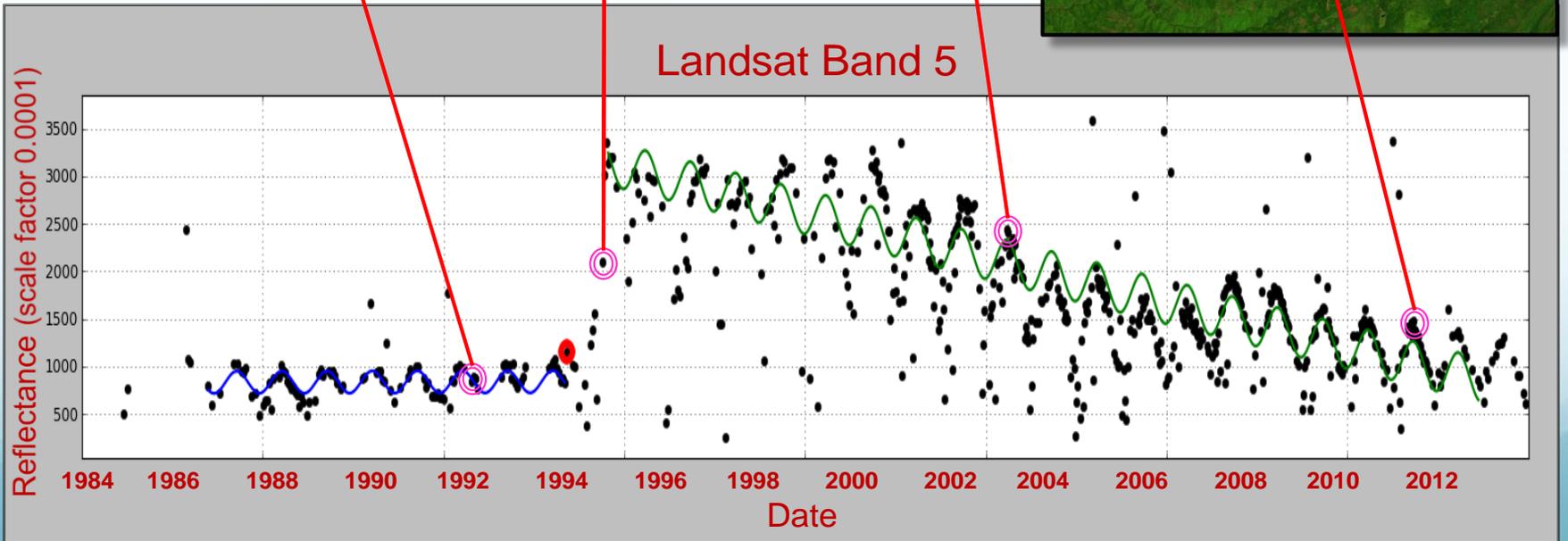
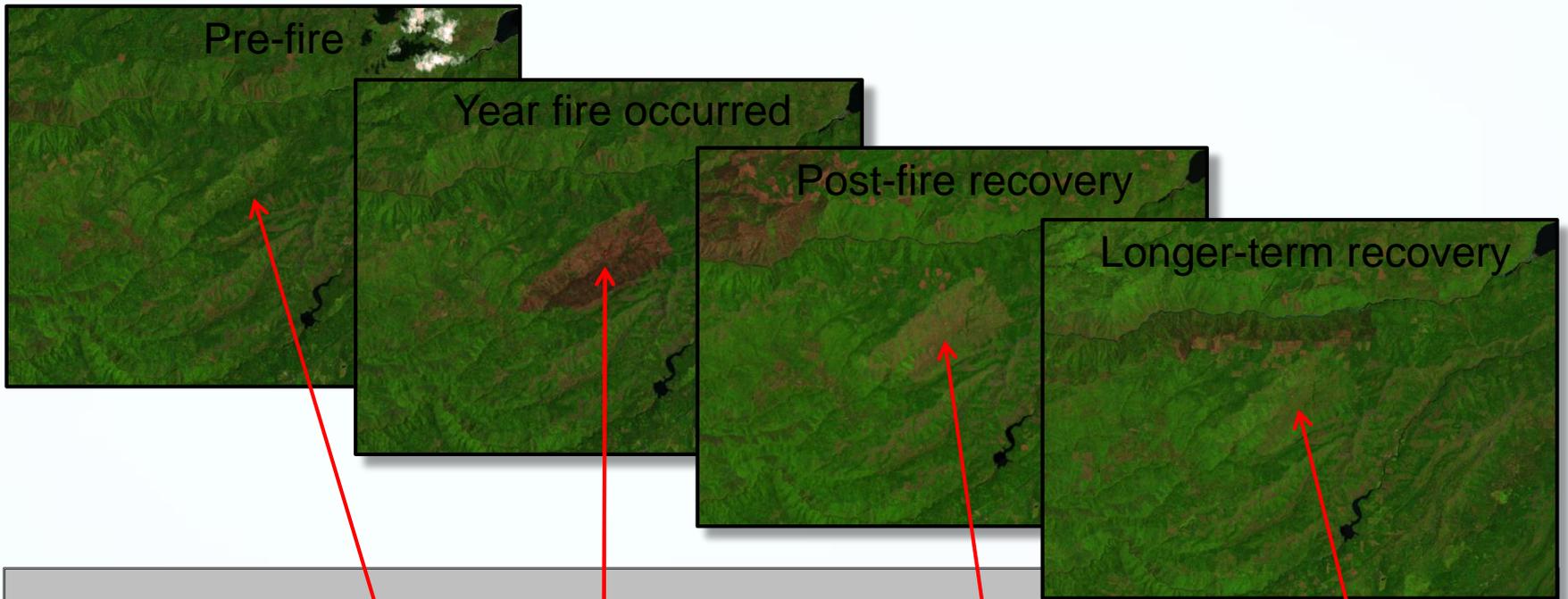
Peter Doucette

- Analysis Ready Data concept (ARD) – reduce the burden of cal/val processing to general scientific community
- Basis is still L1T
- TOA, Surface Temp, Brightness Temp – common cartographic projection
- Prototype Surface Reflectance

Land Change Monitoring, Assessment, and Projection (LCMAP)

- A robust capability that uses daily Landsat observations to detect landscape change as it is occurring
- A transformative Landsat science data archive that is “analysis ready” and capable of supporting near real-time science and applications
- Scientific and geographic evidence of the value of high frequency land change monitoring for improving the understanding of change dynamics
- Target all US land area by Pecora Conference 2017





There is a global need for Space Data Services



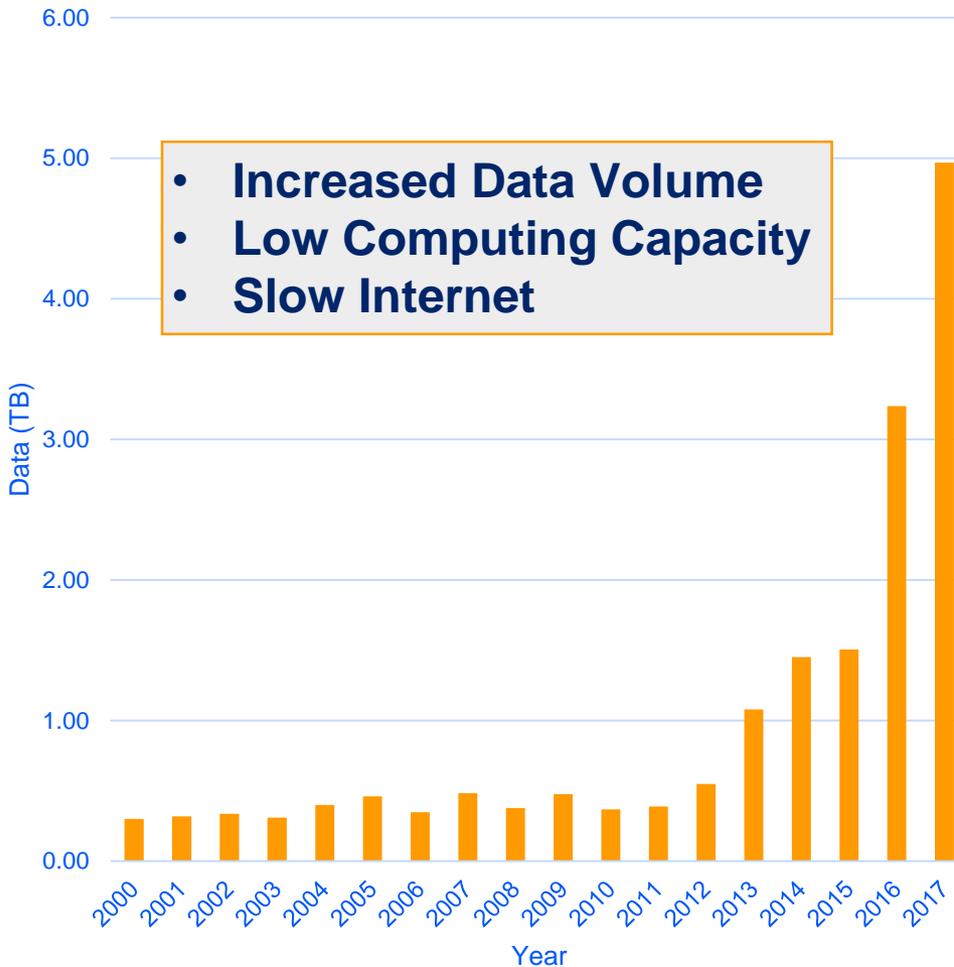
- Many countries lack the knowledge, infrastructure, and resources to access and use space-based data.
- Countries have expressed a desire for support from CEOS by providing: search & discovery tools, cloud-based storage and processing, and training & capacity building.
- CEOS is leading several projects to demonstrate data services tools and build an architecture that supports a growing volume of data.
- It is expected that these data services pilot projects will provide a foundation for future operational systems that will be funded and managed by UN organizations and/or individual countries.
- CEOS agencies have a keen interest in this activity since it promotes the use and benefit of satellite data.



Data Services



Land Imaging Data Growth over Kenya



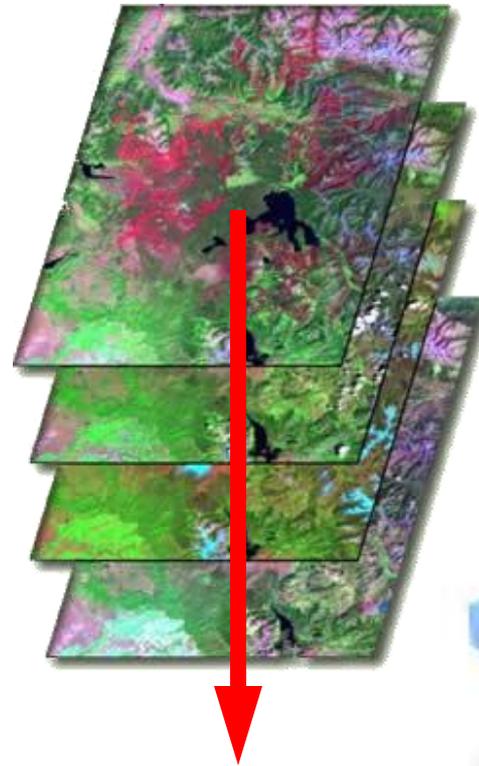
- A significant growth in land imagery data (optical and radar) from Landsat (NASA/USGS) and Sentinel (EC/ESA) will increase data volumes by >10 times in the next few years.
- Kenya could have 5TB of annual Landsat and Sentinel-2 data by 2017.
- **Recent testing ...** Processing a scene takes ~1 minute in U.S. and ~1 hour in Kenya. Downloading a scene takes ~6 seconds in U.S. and ~30 minutes in Kenya. Too much time is spent with image preparation!

We need a better solution ...



- Proven concept in Australia by Geoscience Australia and the Australian Space Agency (CSIRO).
- A multi-dimensional (space, time, data layers) **Data Cube** is an efficient and effective solution!
- **Shift in Paradigm** ... Pixels vs Scenes (no pixels lost)
- **Analysis Ready” Data** Products vs. Unprocessed Data (leave processing to the Space Agencies).
- **Data Cube** approach supports an infinite number of applications, makes it easier for users to access and use space-based data, and allows efficient time series analyses and data assimilation.

Data Cubes!



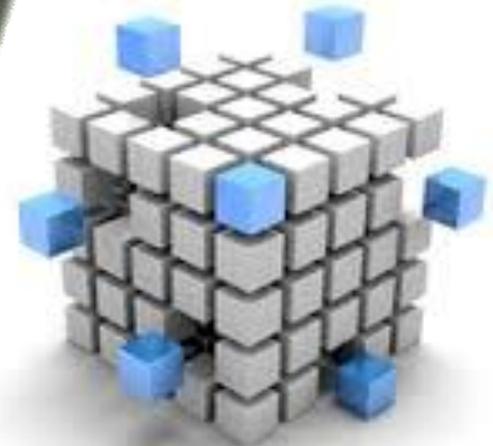
TIME

Data Layer #1

Data Layer #2

Data Layer #3

Data Layer #4





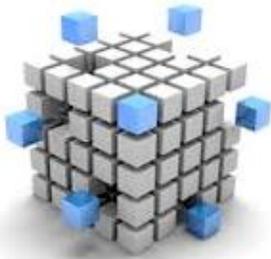
- The CEOS **Data Cube** infrastructure is the best and most popular international free and open source software toolset for creating local, regional or national pixel-based time-series of multiple datasets that are spatially aligned according to user needs (spatial region, time period, data layers, grid projection).
- Users can connect free/open user interface tools to the Data Cube for common analyses (cloud-free mosaics, change detection, pixel-based time series) or utilize APIs to develop their own tools to query the content.
- Users no longer use scene-based tools for time-series analyses, but prefer Data Cubes for improved performance
- Space Agencies systematically supply analysis- ready data products that are easily ingested into Data Cubes





*Analysis-Ready
Data Products*

Ingestor



Data Cubes

API

User Interface

- Working with CEOS Space Agencies to develop plans for sustained provision of Analysis Ready Data (ARD) products.
- Sentinel-1A and Sentinel-2A are the highest priority.

- Testing prototype Data Cubes for **Kenya and Colombia**. Testing local, regional hub and cloud deployment options.
- Developing ingestors to add more datasets: SRTM, ALOS Mosaics, MODIS, SPOT-5, Sentinel-1A/2A.
- Improving ingestor software (creation) and data cube application software (analysis) performance

- Developing and testing prototype common user interfaces for the Kenya and Colombia.
- Considering features such as: custom mosaic creation, time-series statistics, change detection (water/flooding, land type/use, vegetation anomaly).
- Developing APIs for users to create their own user interfaces

USGS Search Exercise – 14 April 2015 – 14 April 2016

EE EarthExplorer x
earthexplorer.usgs.gov

Use Data Set Prefilter [\(What's This?\)](#)

Data Set Search:

- AVHRR
- CEOS Legacy
- CIDR Requirements
- Commercial Satellites
- Declassified Data
- Digital Elevation
- Digital Line Graphs
- Digital Maps
- EO-1
- Global Fiducials
- Global Land Survey
- HCMM
- ISERV
- Land Cover
- Landsat Archive
- Landsat Legacy
- Landsat MRLC
- NASA LPDAAC Collections
- Radar
- Sentinel
 - Sentinel-2
- Vegetation Monitoring

Clear All Selected Additional Criteria » Results »

Google
Map data ©2016 INEGI Imagery ©2016 NASA, TerraMetrics | 1000 km | Terms of Use
The up-to-date Google map is not for purchase or for download; it is to be used as a guide for reference and search purposes only.

Digital Globe, Landsat, Sentinel 2a w/i EarthExplorer

USGS Search Exercise – 14 April 2015 – 14 April 2016

The screenshot shows the EarthExplorer web application interface. The browser address bar displays "earthexplorer.usgs.gov". On the left side, there is a "Data Set" dropdown menu with the following options: GEOEYE-1 Authorized (highlighted), QUICKBIRD-2 Authorized, WORLDVIEW-1 Authorized, WORLDVIEW-2 Authorized, WORLDVIEW-3 Authorized, L8 OLI/TIRS, L7 ETM+ SLC-off (2003-present), and Sentinel-2. Below the list are two buttons: "View Item Basket" and "Submit Standing Request". The main area is a satellite map of Texas and surrounding regions, with a red location pin placed over Fort Worth. The map shows major cities like Dallas, Austin, Houston, and San Antonio, along with interstate highways. The Google logo is visible in the bottom left of the map area. At the bottom of the map, there is a disclaimer: "The up-to-date Google map is not for purchase or for download; it is to be used as a guide for reference and search purposes only."

Digital Globe, Landsat, Sentinel 2a w/i EarthExplorer

USGS Search Exercise – 14 April 2015 – 14 April 2016

EE EarthExplorer
earthexplorer.usgs.gov

Snow Result Controls

Data Set [Click here to export your results](#)

L8 OLI/TIRS

« First Previous 1 Next Last »

Displaying 1 - 23 of 23

1 Entity ID:LC80270372016092LGN00
Coordinates:33.17724,-97.07906
Acquisition Date:01-APR-16
Path:27
Row:37

2 Entity ID:LC80270372016076LGN00
Coordinates:33.17703,-97.08977
Acquisition Date:16-MAR-16
Path:27
Row:37

3 Entity ID:LC80270372016060LGN00
Coordinates:33.17683,-97.08196
Acquisition Date:29-FEB-16
Path:27
Row:37

4 Entity ID:LC80270372016044LGN00
Coordinates:33.17691,-97.07384
Acquisition Date:13-FEB-16
Path:27
Row:37

[View Item Basket](#) [Submit Standing Request](#)

Google
Map data ©2016 Google, INEGI Imagery ©2016 TerraMetrics | 20 km | [Terms of Use](#) | [Report a map error](#)

The up-to-date Google map is not for purchase or for download; it is to be used as a guide for reference and search purposes only.

Landsat 8 L1T w/i EarthExplorer

USGS Search Exercise – 14 April 2015 – 14 April 2016

EE EarthExplorer
earthexplorer.usgs.gov

Snow Result Controls

Data Set [Click here to export your results](#)

L7 ETM+ SLC-off (2003-present)

NOTE: A maximum of five hundred Landsat scenes can be requested for download processing at a time. Landsat scenes added over that amount will have to be removed from the Item Basket before submitting the request.

« First » Previous 1 Next » Last »

Displaying 1 - 22 of 22

1		Entity ID:LE70270372016100EDC00 Acquisition Date:09-APR-16 Path:27 Row:37
2		Entity ID:LE70270372016084EDC00 Acquisition Date:24-MAR-16 Path:27 Row:37
3		Entity ID:LE70270372016068EDC00 Acquisition Date:08-MAR-16 Path:27 Row:37
4		Entity ID:LE70270372016052EDC00 Acquisition Date:21-FEB-16 Path:27

[View Item Basket](#) [Submit Standing Request](#)

The up-to-date Google map is not for purchase or for download; it is to be used as a guide for reference and search purposes only.

Landsat 7 L1T w/i EarthExplorer

USGS Search Exercise – 14 April 2015 – 14 April 2016

EE EarthExplorer
earthexplorer.usgs.gov

Snow Result Controls

Data Set [Click here to export your results](#)

Sentinel-2

« First « Previous 1 Next » Last »

Displaying 1 - 4 of 4

Entity
ID:S2A_OPER_MSI_L1C_TL_MTI_20160215T172945
Coordinates:32.9333863, -97.343162
Acquisition Date:2016/02/15

Entity
ID:S2A_OPER_MSI_L1C_TL_MTI_20160202T171459
Coordinates:32.9333863, -97.343162
Acquisition Date:2016/02/02

Entity
ID:S2A_OPER_MSI_L1C_TL_MTI_20160116T172531
Coordinates:32.9333863, -97.343162
Acquisition Date:2016/01/16

Entity
ID:S2A_OPER_MSI_L1C_TL_MTI_20151217T172743
Coordinates:32.9333863, -97.343162
Acquisition Date:2015/12/17

[View Item Basket](#) [Submit Standing Request](#)

Google
Map data ©2016 Google Imagery ©2016 TerraMetrics 20 km Terms of Use Report a map error

The up-to-date Google map is not for purchase or for download; it is to be used as a guide for reference and search purposes only.

Sentinel 2a w/i EarthExplorer

USGS Search Exercise – 14 April 2015 – 14 April 2016

EE EarthExplorer
earthexplorer.usgs.gov

Search Criteria Data Sets Additional Criteria **Results**

4. Search Results

If you selected more than one data set to search, use the dropdown to see the search results for each specific data set.

Show Result Controls

Data Set [Click here to export your results »](#)

Landsat Surface Reflectance - L8 OLI/TIRS

« First Previous 1 Next Last »

Displaying 1 - 17 of 17

1		Entity ID:LC80270372015361LGN00 Coordinates:33.17694,-97.07863 Acquisition Date:27-DEC-15 Path:27 Row:37
2		Entity ID:LC80270372015345LGN00 Coordinates:33.17712,-97.06979 Acquisition Date:11-DEC-15 Path:27 Row:37
3		Entity ID:LC80270372015329LGN00 Coordinates:33.17692,-97.07962 Acquisition Date:25-NOV-15 Path:27 Row:37

LE70270372016004E....zip LC80270372016044L....zip LC80270372015345L....zip S2A_OPER_MSI_L1C_T....tif Show all downloads...

Search Criteria Summary (Show) **Clear Criteria**

Map Satellite (34° 46' 55" N, 098° 01' 31" W) Options Overlays

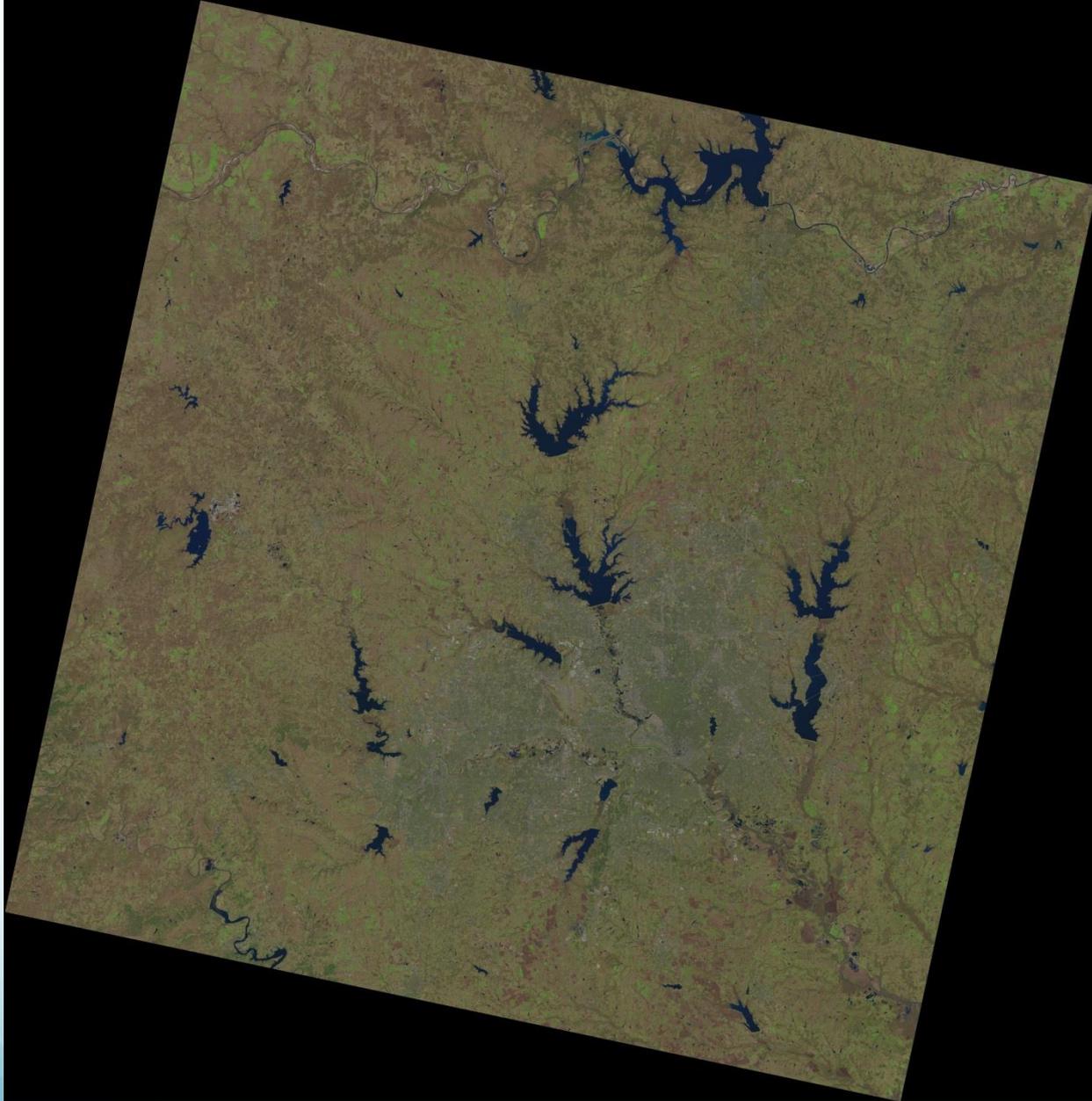
Map showing Fort Worth, Texas area with search results overlaid.

Landsat 8 Surface Reflectance w/i EarthExplorer

S-2A 15 Feb 2016

Image Courtesy of the
European Copernicus Program





Complexities / Challenges (revisited)

- Single sensor
- Single Mission – multi-sensor simultaneous acquisitions
- Single series
- Two Missions (e.g. CBERS 4-Landsat-8, Sentinel-2A – Landsat 8)
- Similar spectrum
- Diverse Spectrum
- Multiple Viewing Angles

- Where should cross-product characterization / evaluation take place?

- **Spectroscopy**